

MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education Ordinary Level

Paper 1 Multiple Choice

October/November 2019

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE IN ANY BARCODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Data Sheet is printed on page 19.

A copy of the Periodic Table is printed on page 20.

The use of an approved scientific calculator is expected, where appropriate.

- 21 A student carried out an experiment to study the rate of reaction when a piece of magnesium was added to some dilute hydrochloric acid.

Which piece of apparatus is **not** required for this experiment?

- A conical flask
- B stop-watch
- C gas syringe
- D Bunsen burner

- 22 Solid X is dissolved in water in a test-tube.

Aqueous sodium hydroxide is added to the test-tube and a white precipitate forms.

The white precipitate dissolves in excess aqueous sodium hydroxide.

Powdered aluminium is now added to the test-tube and the mixture is carefully heated.

A gas is evolved which turns damp red litmus paper blue.

What is X?

- A ammonium sulfate
- B iron(II) nitrate
- C lead(II) nitrate
- D zinc sulfate

- 23 An atom of fluorine is represented by ${}^{19}_{9}\text{F}$.

What is the electron arrangement of the fluoride ion?

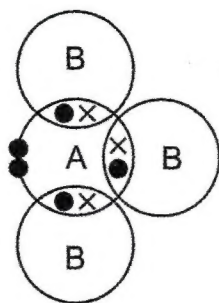
- A 2,6 B 2,7 C 2,8 D 2,8,1

- 24 Sodium chloride, NaCl , is an ionic compound.

Which statement about sodium chloride is **not** correct?

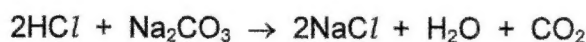
- A It contains positive and negative ions.
- B It dissolves in water.
- C It has a low melting point.
- D The ions are arranged in a giant crystal lattice.

- 25 Two elements, A and B, form a compound of formula AB_3 . A 'dot and cross' diagram of a molecule of AB_3 is shown. Only the outer shell electrons are shown.



Which statement is **not** correct?

- A The molecule contains a total of eight electrons.
 - B A and B are both non-metals.
 - C A is in Group V of the Periodic Table.
 - D B is hydrogen.
- 26 Which ions are present in solid chromium sulfate, $Cr_2(SO_4)_3$?
- A Cr^{2+} and SO_4^{2-}
 - B Cr^{3+} and SO_4^{2-}
 - C Cr^{2+} and SO_4^{3-}
 - D Cr^{3+} and SO_4^{3-}
- 27 0.1 mol/dm^3 hydrochloric acid reacts with 25.0 cm^3 of 0.2 mol/dm^3 aqueous sodium carbonate.
- The equation for this reaction is shown.



What is the volume of acid required to completely react with this volume of sodium carbonate?

- A 6.25 cm^3 B 25 cm^3 C 50 cm^3 D 100 cm^3

- 28 Solutions of two chemicals are mixed in a beaker.

A reaction occurs and a decrease in temperature is observed.

Which statement is correct?

- A An endothermic reaction occurs and the reacting chemicals gain energy.
- B An endothermic reaction occurs and the reacting chemicals lose energy.
- C An exothermic reaction occurs and the reacting chemicals gain energy.
- D An exothermic reaction occurs and the reacting chemicals lose energy.

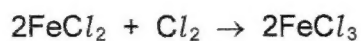
29 Copper(II) oxide reacts with sulfuric acid.

Which change increases the rate of reaction by increasing the movement of the particles?

- A increase in concentration of sulfuric acid
- B increase in surface area of copper(II) oxide
- C increase in temperature of sulfuric acid
- D using a catalyst

30 Chlorine reacts with iron(II) chloride.

The equation for the reaction is shown.



Which statement about the reaction is correct?

- A The iron(II) chloride is an oxidising agent and is oxidised.
- B The iron(II) chloride is an oxidising agent and is reduced.
- C The iron(II) chloride is a reducing agent and is oxidised.
- D The iron(II) chloride is a reducing agent and is reduced.

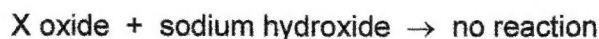
31 The volume of gas produced in a reaction is measured against time.

Which results show the **slowest** average rate of reaction?

	total volume of gas / cm ³	time taken / s
A	10	2
B	12	6
C	20	20
D	36	18

- 32 The oxide of an element X is added separately to hydrochloric acid and aqueous sodium hydroxide.

The word equations for the reactions are shown.



Which row describes element X and its oxide?

	X	X oxide
A	metal	acidic
B	metal	basic
C	non-metal	amphoteric
D	non-metal	acidic

- 33 Some information about Group I elements is shown.

element	atomic number	atomic radius / pm	melting point / °C
lithium	3	152	180
sodium	11	186	98
potassium	19	231	64

Which statement about the trends shown by the elements in Group I of the Periodic Table is **not** correct?

- A As the atomic number increases the melting point decreases.
- B As the number of electrons increases the elements are more reactive with water.
- C As the number of electron shells increases an electron is less easily lost.
- D As the number of protons increases the atomic radius increases.
- 34 Astatine is at the bottom of Group VII in the Periodic Table.

Which row describes the properties of astatine?

	colour	state	reaction with aqueous potassium bromide
A	black	liquid	bromine displaced
B	black	solid	no reaction
C	black	solid	bromine displaced
D	brown	liquid	no reaction

35 The reactions of four metals are shown.

metal	reaction with cold water	reaction with steam	reaction with dilute acid
W	gentle reaction	vigorous reaction	vigorous reaction
X	vigorous reaction	violent reaction	violent reaction
Y	no reaction	no reaction	no reaction
Z	vigorous reaction	violent reaction	explosive

What is the order of reactivity of the metals?

	<div> <div>most reactive</div> <div>→</div> <div>least reactive</div> </div>			
A	W	X	Z	Y
B	X	Z	Y	W
C	Y	W	Z	X
D	Z	X	W	Y

36 Four statements about the recycling of metals are listed.

- 1 More energy is required to mine and extract a metal than to recycle it.
- 2 The recycling of metals involves transport, separation and reprocessing.
- 3 Some metals are present in the Earth's crust in very small quantities.
- 4 People in the future will need metals.

Which statements give valid reasons in favour of recycling metals?

- A 1 and 2 B 1 and 3 C 2 and 4 D 1, 3 and 4

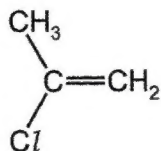
37 Which noble gas has the highest percentage composition in dry air?

- A argon
B helium
C krypton
D neon

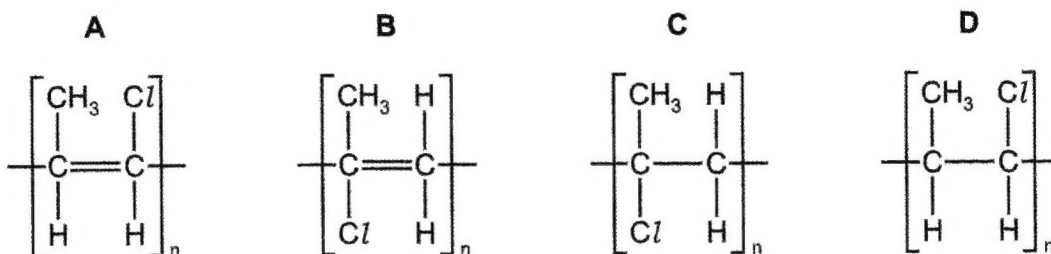
38 Which statement about alkanes is correct?

- A A molecule of propane contains two carbon atoms.
- B The general formula is C_nH_{2n} .
- C The products of complete combustion are carbon monoxide and water.
- D They react with chlorine in a substitution reaction.

39 The structure of a monomer is shown.



What is the structure of the polymer formed by this monomer?



40 An organic compound E reacts with acidified potassium manganate(VII) solution causing a colour change.

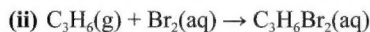
What is E?

- A ethane
- B ethanoic acid
- C ethanol
- D poly(ethene)

- (c) (i) method: Bubble both gases into different test-tubes containing bromine solution.
- observations: For propene, the colour of the bromine solution changes from reddish-brown to colourless. For propane, there is no change in the colour of the bromine solution.

EXAM TIP:

The addition of bromine is used to distinguish between an alkane and an alkene.



10. (a) (i) Astatine
- (ii) Fluorine is positioned highest in Group VII of the Periodic Table, thus it is the most reactive halogen.
- (b) Down Group VII, the intermolecular forces of attraction between the molecules become stronger. More energy is required to overcome the stronger intermolecular forces of attraction between molecules, resulting in a higher melting point down Group VII.
- (c) (i) $\text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow 2\text{Cl}^-(\text{aq}) + \text{Br}_2(\text{aq})$
- (ii) The colourless bromide solution turns reddish brown.

EXAM TIP:

A more reactive halogen displaces a less reactive halogen from its halide solution.

- (d) 1 mole of Cl_2 gas liberates 2 moles of HCl gas.
- Volume of chlorine gas = $3000 \div 2$
 $= 1500 \text{ dm}^3$

EXAM TIP:

Use the mole ratio provided by the balanced equation to find the volume of chlorine needed.

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Paper 1

Multiple Choice Questions

21. (D)

To study the rate of reaction between magnesium and dilute hydrochloric acid, the volume of hydrogen gas per unit time is measured. A conical flask is required to contain the chemicals; a stopwatch is required to measure the time intervals of the reaction; a gas syringe is required to measure the volume of hydrogen gas produced at regular time intervals.

EXAM TIP:

A Bunsen burner is not required for this experiment as heating of the reaction mixture is not required.

22. (C)

Since solid X forms white precipitate in aqueous sodium hydroxide, which is soluble in excess sodium hydroxide, X could contain zinc, aluminium or lead ion. When powdered aluminium is added to the test-tube and carefully heated, ammonia gas is evolved which turns damp red litmus paper blue. This indicates the presence of nitrate ion. From the information given, out of all 4 options, X can only be lead(II) nitrate.

EXAM TIP:

Recall the test for cation and anion. A gas that turns damp red litmus paper blue is alkaline.

23. (C)

Fluorine atom gains 1 electron to form fluoride ion to attain a noble gas electronic configuration. Thus fluoride ion has an electronic configuration of 2,8.

EXAM TIP:

Determine the number of electrons and electronic configuration of the element and its corresponding ion.

24. (C)

Sodium chloride (NaCl) contains positive ions (Na^+) and negative ions (Cl^-), which are arranged in a giant crystal lattice. There are strong electrostatic forces of attraction between the positive and negative ions. A large amount of energy is required to overcome the strong forces of attraction, thus NaCl has a high melting point. It is also soluble in water.

EXAM TIP:

Ionic compounds have high melting points.

25. (A)

Based on the 'dot and cross' diagram, it can be deduced that AB_3 is a covalent compound. Thus, both A and B are non-metals. Since A has 5 valence electrons, it belongs to Group V of the Periodic Table. B is hydrogen as it is a non-metal with only 1 valence electron. Only the outer shell electrons are shown in the 'dot and cross' diagram, so the molecule actually contains a total of more than eight electrons.

EXAM TIP:

From the 'dot and cross' diagram, determine the type of compound AB_3 is and its corresponding atoms.

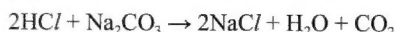
26. (B)

From the chemical formula, chromium sulfate contains Cr^{3+} ions and SO_4^{2-} ions.

EXAM TIP:

Identify the charge of the ions present based on the chemical formula.

27. (D)



$$\begin{aligned} \text{Number of moles of Na}_2\text{CO}_3 &= 0.2 \times \frac{25}{1000} \\ &= 0.005 \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{Number of moles of HCl} &= 2 \times 0.005 \\ &= 0.01 \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{Volume of HCl} &= 0.01 \div 0.1 \\ &= 0.1 \text{ dm}^3 \\ &= 100 \text{ cm}^3 \end{aligned}$$

EXAM TIP:

Step 1: Calculate the number of moles of Na_2CO_3 present.
Step 2: From the balanced equation, determine the number of moles of HCl required.
Step 3: Calculate the volume of HCl required.

28. (A)

A decrease in temperature indicates it is an endothermic reaction as heat is absorbed. As a result, reacting chemicals gain energy from the surroundings.

EXAM TIP:

In an endothermic reaction, energy is taken in from the surroundings and this is detected as a decrease in temperature. In an exothermic reaction, energy is given out to the surroundings and this is detected as a rise in temperature.

29. (C)

An increase in temperature of sulfuric acid will increase the kinetic energy of particles, thus the movement of the particles will increase. The changes indicated in the rest of the options will not increase the movement of the particles, but will only increase the frequency of effective collisions.

EXAM TIP:

A change in temperature affects the speed of the movement of the particles and therefore the rate of reaction.

30. (C)

The oxidation state of Cl decreases from 0 in Cl_2 to -1 in FeCl_3 . Since iron(II) chloride reduces Cl_2 , it is a reducing agent. Also, iron(II) chloride is oxidised as the oxidation state of Fe increases from $+2$ in FeCl_2 to $+3$ in FeCl_3 .

EXAM TIP:

Identify the oxidation states of the respective elements before and after the reaction to determine the species involved in oxidation and reduction respectively.

31. (C)

$$\text{Average rate of reaction} = \frac{\text{Total volume of gas}}{\text{Time taken}}$$

The smaller the total volume of gas produced per unit time, the slower the average rate of reaction. Thus (C) is the answer.

EXAM TIP:

Calculate the average rate of reaction for all 4 options and identify the one with the slowest average rate of reaction.

32. (B)

Since the oxide of element X can react with an acid but not with a base, it is a basic oxide. Metals usually form basic oxides, hence (B) is the answer.

EXAM TIP:

Basic oxides react with acids to form salt and water, and do not react with bases.

33. (C)

From the table, as the atomic (or proton) number increases, the melting point decreases. As the atomic number increases, the number of protons increases and the atomic radius increases. Hence (A) and (D) are correct.

Down Group I, the elements are more reactive with water. Hence, (B) is correct. However, as the number of electron shells increases, an electron is more easily lost due to weaker electrostatic forces of attraction between the positive nuclei and the valence electrons. Thus, (C) is the answer.

EXAM TIP:

Observe the trends indicated by the information in the table. Recall the general physical and chemical properties of Group I metals.

34. (B)

Down Group VII, the colour becomes darker, the melting and boiling point increases and reactivity decreases. As astatine is positioned below iodine in the Periodic Table, astatine will appear black in colour, solid in room temperature and cannot displace the more reactive bromine from aqueous potassium bromide.

EXAM TIP:

Recall the general trend and properties of Group VII elements.

35. (D)

Z is the most reactive metal as it reacts explosively with dilute acid, followed by X which reacts violently with dilute acid, then W which reacts vigorously with acid, and Y is the least reactive as it does not react with dilute acid.

Thus the order of reactivity is $Z > X > W > Y$.

EXAM TIP:

Deduce the relative position in the reactivity series based on their reactivity with cold water, steam and dilute acid.

36. (D)

Statements 1, 3 and 4 give valid reasons in favour of recycling metals. Statement 2 gives the disadvantage of recycling.

EXAM TIP:

Recycling metals results in the conservation of energy and is important as metals are finite resources.

37. (A)

EXAM TIP:

The volume composition of gases present in dry air is approximately 78% nitrogen, 21% oxygen and the remainder (approximately 1%) comprises noble gases (with argon as the main constituent) and carbon dioxide.

38. (D)

Propane contains three carbon atoms, hence (A) is incorrect.

The general formula of alkanes is C_nH_{2n+2} , hence (B) is incorrect.

Complete combustion of alkanes produces carbon dioxide and water, hence (C) is incorrect.

Alkanes undergo substitution reaction with chlorine to produce chloroalkanes, hence (D) is correct.

EXAM TIP:

Recall the general physical and chemical properties of alkanes.

39. (C)

In addition polymerisation, the double bonds are broken and joined with another monomer to form the polymer.

EXAM TIP:

Identify the double bonds in the structure and deduce the structure of the repeat unit.

40. (C)

Alcohols undergo oxidation reaction in the presence of acidified potassium manganate(VII) to form carboxylic acids.

Thus, compound E is ethanol.

EXAM TIP:

Acidified potassium manganate(VII) solution is an oxidising agent.

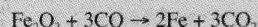
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Paper 3

Section A

1. (a) carbon monoxide

EXAM TIP:



(b) calcium hydroxide (or calcium oxide)

EXAM TIP:

When soil is too acidic, it can be treated with bases such as quicklime (calcium oxide) or slake lime (calcium hydroxide).

(c) yeast

EXAM TIP:

Yeast is added to glucose to produce ethanol and carbon dioxide.

(d) hydrogen

EXAM TIP:

To produce margarine, hydrogen is added to unsaturated vegetable oils.

2.

property	proton	neutron	electron
relative mass	1	1	$\frac{1}{1840}$
relative charge	1+	no charge	1-

3. (a) boiling point

EXAM TIP:

Fractional distillation is used to separate a mixture of miscible liquids with different boiling points.

(b) The vapour is cooled in the condenser and condenses into liquid, which is collected in the conical flask.

EXAM TIP:

In the condenser, the hot petroleum vapour condenses as running water cools it.

(c) Petrol fraction consists of a mixture of hydrocarbons. As it is a mixture of substances with different boiling points, it boils over a range of temperatures.

EXAM TIP:

Recall petroleum as a mixture of hydrocarbons and recall that a mixture boils over a range of temperatures.

(d) 1. Naphtha
2. Kerosene
(Other acceptable answers: diesel or lubricating oil.)

EXAM TIP:

Recall the different fractions of petroleum.

(e) (i) chloride ion

EXAM TIP:

Silver nitrate is used to test for the presence of chloride ions.

(ii) water

EXAM TIP:

Aqueous salt is a mixture of water and salt; hence water will be collected as distillate.